The Rent Term Premium for Cancellable Leases[#]

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Jiro Yoshida[*]

Miki Seko[**]

Kazuto Sumita[***]

Abstract

This study analyzes the rent term premium for leases that can be cancelled by the lessee. We model the lessor's trade-off between leasing costs and the cost of cancellation options based on the recognition that many leases are cancellable by lessees, and lease markets involve significant transaction costs. We demonstrate that, regardless of the expected future rents, the rent term structure is upward-sloping when there is no leasing cost but U-shaped when the lessor faces moderate leasing costs. Residential leases in Japan, which are all cancellable by tenants, exhibit the term structure that is consistent with our calibrated model.

(*JEL*: G12, G13, R31)

Keywords: leasing, housing, asset pricing, cancellation options, term structure, expectations hypothesis, transaction costs, hedonic regression, Japan

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* Haas School of Business, University of California, Berkeley, S545 Student Services Bldg., #1900, Berkeley, CA 94720-1900, USA. Phone: 814-753-0578. Fax: 814-865-6284. Email: jiro@berkeley.edu.

** Faculty of Economics, Musashino University, 3-3-3 Ariake, Koto-ku, Tokyo, 135-8181, Japan. Email: seko@econ.keio.ac.jp.

*** Faculty of Economics, Toyo University, 5-28-20, Hakusan, Bunkyo-ku, Tokyo 112-8606, Japan. Email: sumita@toyo.jp.

Introduction

Leasing markets have become sizable in many countries because leasing can be especially beneficial to financially constrained young individuals and small firms (e.g., Eisfeldt and Rampini, 2009; Sharpe and Nguyen, 1995; Ho et al., 2004; Beck and Demirguc-Kunt, 2006; and Devos et al., 2012). In the U.S., the estimated value of leased real estate in 2010 was approximately 5.2 trillion dollars; for comparison, this quantity was roughly equal to half of the 2010 U.S. GDP or half of the outstanding U.S. federal debt in 2010.[1] In addition, nearly all firms in a Compustat sample use operating leases for equipment (Graham et al., 1998). If operating leases for equipment were capitalized, the capitalized value of these leases in 2010 would have been approximately 2 trillion dollars.[2]

Leases are arranged with a wide range of lease terms; e.g., lease terms range from one year to over 10 years for aircrafts and real estate. The rent term premium is important because it incorporates information about expectations for future equilibrium lease rates, analogous to the way in which a bond yield curve contains information about future interest rates. A positive term premium (i.e., an upward-sloping term structure) is typically regarded as reflective of rents that are currently low but projected to gradually increase in accordance with the expectation hypothesis (e.g., Grenadier, 1995; and Gunnelin and Soderberg, 2003).

However, leases are different from standard bonds in at least two important ways. First, many leases are cancellable by lessees (hereafter, referred to as cancellable leases). Operating leases for equipment, which constitute a larger part of equipment lease markets than finance leases, are typically cancellable. Real estate leases also permit early cancellation especially for commercial real estate and

[1] Source: The Real Estate Roundtable, 2011 Annual Report. Available at http://www.rer.org.
[2] Source: The Equipment Leasing and Finance Foundation, Economic Impacts of the Proposed Changes to Lease Accounting Standards, December 12, 2011. Available at http://www.leasefoundation.org.

for residential real estate in Europe and Asia. By contrast, callable (i.e., cancellable) bonds are not as common as cancellable leases. Although extant studies analyze cancellable leases, these investigations do not focus on the rent term structure (e.g., Copeland and Weston, 1982; Schallheim and McConnell, 1985; Mooradian and Yang, 2000; and Giaccotto, Goldberg, and Hegde, 2007). Second, lease markets involve significant transaction costs that are associated with contracting and market illiquidity. When a lease contract expires, the lessor needs to search for a new lessee. It is not uncommon for a rental property to be vacant for weeks or even months before a new lease contract is signed. Thus, it is important to understand the term structure for cancellable lease contracts that involve significant leasing costs.

Geltner et al. (2013, p. 795) discuss that the rent term premium is affected by various factors such as the cost and risk associated with releasing, the landlord's redevelopment option, tenants' preferences for flexibility, and hold-up problems. They predict that, due to the risk associated with lease renewal, "the equilibrium or normative term structure of rents will be downward-sloping relative to the projection of future spot market rents." Other studies also analyze the rent term structure by introducing tenants' credit risks, the presence of imperfect competition, and multiple options (e.g., Grenadier, 2005; Ambrose and Yildirim, 2008; Agarwal et al., 2011; and Chang et al., 2012). However, these theories cannot perfectly explain actual lease-related data (e.g., Stanton and Wallace, 2009; and Bond, Loizou and McAllister, 2008). Geltner et al. conclude that "empirical evidence is still too scarce to shed much light on the question."

In this study, we provide new theoretical and empirical evidence regarding the rent term premium for cancellable leases. We first prove that the term premium is always positive for cancellable leases in a frictionless market. In other words, an upward-sloping term structure should be observed in this environment regardless of the prospect of future rent appreciation. Then, we demonstrate that when there are sufficiently large leasing costs for the lessor, lease rates exhibit a U-shaped term structure;

i.e., the short end of the term structure slopes downward while the long end of the term structure slopes upward. We confirm that our calibrated model is consistent with the empirically estimated term structure using Japanese residential lease data. Our result sheds light on the equilibrium rent term structure when lease contracts include cancellation options.

To develop a model of cancellable leases, we adopt the lease valuation approach that is taken by McConnell and Schallheim (1983) and Grenadier (1995). However, in their models with a deterministic discount factor, the expectations hypothesis necessarily holds because there is no risk premium. Thus, we introduce the stochastic discount factor as in the study by Clapham and Gunnelin (2003) and allow the effect on rent of the market price of risk and the correlations between rents and the discount factor. Furthermore, unlike these extant models, we explicitly take into account the lessor's leasing costs because they are a key characteristic that differentiates leases from other financial assets. Moreover, we characterize the equilibrium in our model under various supply- and demand-side conditions. For example, we discuss cases in which lessors and lessees are homogeneous, they are heterogeneous but markets are complete, Rubinstein's (1974) aggregation condition holds, heterogeneous lessors and lessees form hedonic or other separating equilibria, and markets are segmented.

Although Grenadier (1995) also numerically demonstrates an upward sloping term structure in a competitive and frictionless market, we formally prove that the term structure always slopes upward regardless of future rents. More importantly, our study is the first to demonstrate a U-shaped term structure in the presence of transaction costs. For example, although Grenadier (2005) derives a general formula of lease rates under imperfect competition, transaction costs are not taken into account in his model. His analysis of cancellable leases is also confined to an effect of rent volatility on the infinite-term cancellable lease rate (i.e., a single point in the term structure) because the solution for cancellable leases is numerically quite intensive. In contrast, we explicitly analyze the effect on the entire lease term structure of transaction costs, rent volatility, risk-free rate of interest, the risk premium on short-term rents, and the expected rent growth. This is also the first study to empirically analyze the term structure of lease rates in the presence of common lease features of cancellation options and transaction costs.

Our insight into a positive term premium in a frictionless market can be easily understood in a case of deterministic rents. If future rents appreciate, a cancellable lease is equivalent to a non-cancellable lease because a cancellation option will never be exercised. Therefore, a long-term rate reflects a weighted average of higher future rents. By contrast, if future rents depreciate, a long-term lease will be replaced by new leases at lower rents through either the cancellation or renegotiation of lease rates. In this case, there is no term premium because a long-term cancellable lease is equivalent to a roll-over short-term lease. The case of a stochastic short-term rent falls between the scenarios of certain appreciation and certain depreciation. Even if rents are expected to depreciate on average, the term premium is positive as long as there is a positive probability of rent appreciation. Although the effect of a cancellation option could become smaller by penalties or tenants' moving costs, these factors do not qualitatively change our prediction. Idiosyncratic cancellation motives such as moving do not also alter our result because these motives are uncorrelated with market rents.

However, when we incorporate the lessor's costs associated with leasing, the rent term premium can be negative for relatively short-term leases. For example, contracting costs and vacancy costs are costs that are incurred by the lessor at each lease signing. Because a short-term lease is signed more frequently, the lessor's costs are greater for short-term leases than for long-term leases. To compensate for these costs, the lessor will increase short-term rents (e.g., Miceli and Sirmans, 1999). With reasonable assumptions about leasing costs, the rent premium is largest for the shortest-term lease and diminishes as the lease term becomes longer. Thus, when we incorporate both leasing costs and cancellation options, we obtain a U-shaped term structure.

In our numerical simulations, we demonstrate that the slope of term structure becomes steeper when the mean rent growth rate is higher, rent volatility is larger, the risk-free rate is lower, and the risk premium on long-term rents is greater. We also demonstrate that leasing costs make the slope negative at the short end of the term structure. By using a set of reasonable parameters for Japanese residential lease markets, we predict an upward-sloping term structure in a low-cost market and a U-shaped term structure in a high-cost market.

We test the prediction of our model by Japanese residential leases. Japanese residential leases are ideal for our study because they are universally cancellable without penalties and involve a wide range of lease terms. The tenant can terminate a lease contract anytime on one to three months' notice because the Japanese Tenant Protection Law (JTPL) provides tenants with strong legal protection. Under the current JTPL, there are two types of residential lease contracts: fixed-term and general leases. Fixed-term leases, which is similar to an "estate for years" in the U.S. and also common in many countries, were introduced in the March 2000 revision of the JTPL.[3] A fixed-term lease, which typically ranges from 1 to 5 years, is renewed only if both the landlord and the tenant mutually agree to the new contract.

By contrast, the general lease, which has been more commonly used in Japan, is similar to "estate from period to period" or "periodic tenancy" in the U.S. and the U.K., but tenure security is much stronger. For general leases, landlords are obligated to renew contracts and cannot evict incumbent tenants unless they provide a just cause for this eviction that satisfies a judicial court's requirements.[4] Moreover, landlords are rarely able to increase their rents to match appreciations in market rent levels because the court has traditionally ruled in favor of tenants. As a result, a general lease is effectively

[3] This type of lease contract was prevalent before 1941 but eliminated to prevent landlords from evicting incumbent tenants and circumventing rent control during World War II (Survey of New Form of Residence Associated with Fixed-Term Lease Contracts, Housing Research and Advancement Foundation of Japan, March 2015).
[4] This requirement is specified by Article 28 of the Tenure Law, which is known as "Shakuchi-Shakka-Hou" in Japan.

an open-ended fixed-rate lease that can be cancelled only by tenants, and hence it gives us a unique opportunity to test our model for the long end of the term structure.[5]

The objective of introducing fixed-term leases was to address the problems caused by the strong tenant protection associated with general lease. In particular, the number, size, and quality of rental housing were insufficient because landlords were cautious about renting out their properties. For example, Seko and Sumita (2007) point out that the average floor space increased by 43% for owned housing but only 28% for rental housing between 1968 and 2003. However, even after the JTPL revision, the adoption of fixed-term leases has been very slow; fixed-term leases account for only 4.1% of the entire rental housing market in 2013.[6] Understanding rent term structure is crucial in analyzing the relative advantage of fixed-term leases because lease terms are the key difference between general and fixed-term leases.

We estimate by hedonic regressions the term structure of fixed-term lease rates relative to the general lease rate, which is the longest-term rate available in the market. The rent term structure is separately estimated for low- and high-vacancy areas because our model predicts that the term structure depends on the lessor's cost associated with lease cancellation. The estimated term structure is consistent with our calibrated model that incorporates cancellation options and leasing costs; i.e., the term structure is upward-sloping in the low-vacancy area and U-shaped in the high-vacancy area. We also find evidence to support our hypothesis that the market for short-term leases in the high-vacancy area is segmented for relatively low-quality tenants.

During the course of analyzing cancellation options, we also identify a new cause of tenure discounts in real estate lease markets. Tenure discounts refer to the phenomenon that long-standing residential tenants pay less in rent than tenants who entered their contract more recently (e.g.,

[5] See Iwata (2002) and Seko and Sumita (2007) for a discussion of the asymmetric nature of lease restrictions and the effects of the role of these asymmetries as a form of rent control.
[6] Ministry of Land, Infrastructure, Transport, and Tourism, 2013FY Housing Market Survey (Jutaku Shijo Doko Chosa).

Goodman and Kawai, 1985; Hubert, 1995; and Raess and von Ungern-Sternberg, 2002). We reveal that the rents for a repeatedly renegotiated long-term lease tracks the historical minima of market rents for newly arranged cancellable leases. As a result, a long-standing tenant tends to pay a lower rent than the current market rent.

In all, this study provides a new insight into the lessor's optimal choice of rents and the interpretation of the equilibrium rent term premium with an emphasis on the effect of embedded options and leasing costs. In a market for cancellable leases, which are a common type of lease contract, a positive term premium is normally observed even when future rents are expected to decrease and the rent risk premium is negligible. Moreover, in a market with large leasing costs, the term structure is U-shaped even when the expected future rents are constant. Thus, when we estimate the expected future rent from the observed term structure, a relevant adjustment has to be made with respect to the market vacancy rate and option premiums.

Model

In this section, we develop a model of lessees' optimal cancellation decisions and lessors' rational lease pricing. At each point in time, lessees choose from alternative leases on the basis of rental cost, and lessors determine the initial lease rate by anticipating lessees' choices in the future. We adopt a standard approach to modeling the equilibrium rent term premium (e.g., McConnell and Schallheim,1983; Grenadier, 1995; and Clapham and Gunnelin, 2003) but extend the extant models by incorporating a cancellation option and leasing costs.

The Characterization of Cancellable Leases

Consider an economy with discrete times $t = 0, \dots, T$. The underlying uncertainty is represented by a filtered probability space $(\Omega, P, \mathcal{F}, (\mathcal{F}_t)_{t=0,\dots,T})$. Let $\mathrm{E_t}(\cdot)$ denote the conditional expectation given information at t, which is represented by the filtration $\mathcal{F}_t$. Let an adapted stochastic process R_t^T denote the T-period rent for the period between times t and $t+1$, with a payment that occurs at the beginning of each period. We do not impose restrictions on the time-series properties of the rent process, which is determined by the aggregate demand and supply in the leasing market. Let $\hat{R}_0^T$ denote the initial T-period rents for cancellable leases and O^C denote the present value of the lessee's option to cancel a long-term lease.

By using a stochastic discount factor m_t for cash flows at time t and assuming no costs associated with lease renewal, we write the present value of T-period leases as the expected value of the state-contingent lease payments, weighted by the stochastic discount factor:

(1) $V^T = \sum_{t=0}^{T-1} \mathrm{E}_0[R_0^T m_t]$,

(2) $\hat{V}^T = \sum_{t=0}^{T-1} \mathrm{E}_0\left[\hat{R}_0^T m_t\right] - O^C$,

where V^T and $\hat{V}^T$ denote the present values of a non-cancellable long-term lease and a cancellable long-term lease, respectively. Note that $t = T-1$ represents the final period because of the beginning-of-the-period timing convention that is utilized in the above equations. The discount factor m_t equals the lessor's inter-temporal marginal rate of substitution and thus it reflects the lessor's risk aversion and wealth level.[7] When the covariance between the discount factor and lease payments is nonzero, the lease value is adjusted for risk. However, we do not assume a particular level of risk aversion. We also do not assume market completeness.

We impose a condition that the rational lessor consistently values alternative leases: $V^T = \hat{V}^T$, $\forall T$. Although this is equivalent to the no-arbitrage condition for the pricing of financial assets such as bonds (e.g., Gurkaynak and Wright, 2012), we do not require actual transactions of lease assets. This consistency condition is a necessary condition for a variety of equilibria based on different

[7] The stochastic discount factor is derived from the first-order condition for the lessor's utility maximization problem given the lessor's wealth portfolio and consumption stream.

specifications of preferences, technologies, and interest rates. For example, a hedonic equilibrium, which is a separating equilibrium of heterogeneous lessees and lessors, rely on this consistency condition.

We first characterize the dynamics of lessor's rental income from a T-period cancellable lease. Let $\hat{Y}_t^T$ denote the rental income between times t and $t+1$ with this leasing strategy. If the lessee does not cancel the initial lease until time *T*, the rental income remains constant at the initial rent: $\hat{Y}_t^T = \hat{R}_0^T$ for any t. If the lessee wishes to exercise the cancellation option to take advantage of low market rents, the lessor needs to either accept a rent reduction for the incumbent lessee or find a new lessee at the current market rent. The rent $\hat{R}_t^{T-t}$ for a new cancellable lease for the remaining term until time T is determined by the lessor's consistent pricing condition. Thus, the rental income is written as:

(3) $\hat{Y}_t^T = \min\{\hat{Y}_{t-1}^T, \hat{R}_t^{T-t}\}$ for $t = 1, \ldots, T-1$.

The rent can repeatedly be reduced but will never be increased. By this recursive rent revision rule, the rental income is always maintained at the historical minimum of the market rents that have been observed since the beginning of the first lease: $\hat{Y}_t^T = \min\{\hat{R}_u^{T-u}, u = 0, \ldots, t\}$. This rental income is analogous to the coupon rate for the valuation of a callable bond and a prepayable mortgage (see Blume and Keim, 1988, and Follain et al., 1992). By writing present value of a T-period cancellable lease as $\hat{V}^T = \sum_{t=0}^{T-1} \mathrm{E}_0[\hat{Y}_t^T\, m_t]$ and substituting it in Eq. (2), we characterize the cancellation option by the present value of the gap between the initial rent and the repeatedly revised rental income: $O^C = \sum_{t=0}^{T-1} \mathrm{E}_0[(\hat{R}_0^T - \hat{Y}_t^T)\, m_t]$. The option value is larger when the expected future rents are lower. It is easy to demonstrate that the cancellable lease rate is at least as high as the lease rate for an otherwise identical non-cancellable lease: $\hat{R}_0^T \geq R_0^T$.

Figure 1 illustrates a sample path of the simulated market rent $\hat{R}_t^{T-t}$ and the corresponding rental income $\hat{Y}_t^T$ under the T-period leasing strategy. Although the market rent may increase or decrease, the rental income will never increase.[8] This asymmetric revision of rents serves as a new explanation as to why rents for long-standing tenants tend to be lower than current market rents.

=== Figure 1 around here ===

The Term Structure for Cancellable Leases in a Frictionless Market

When there is no leasing cost, the option value should produce an upward-sloping term structure because the initial rent must compensate for the value of a written American option, which increases with the term to maturity. To formally prove this line of reasoning, we compare the following two leasing strategies for a period of length T:

1. The T strategy: The lessor uses a T-period cancellable lease at the initial rate of $\hat{R}_0^T$.
2. The $T-1$ strategy: The lessor uses a $T-1$-period cancellable lease at the initial rate of $\hat{R}_0^{T-1}$, followed by a short-term lease for the final period at R_{T-1}^1.

When the initial lease is cancelled due to a lower market rent, the lessor uses a new cancellable lease for the remaining term until time T.[9] The two strategies must generate the same present value to the lessor to meet the consistency condition. By focusing on the final period, we obtain the following lemma regarding the lease rate:

Lemma: *For the final period that is examined, the T strategy produces rents that are less than or equal to the rents that are obtained with the $T-1$ strategy;* $i.e., \hat{Y}_{T-1}^T - \hat{Y}_{T-1}^{T-1} \leq 0, \text{a.s.}$

Proof: See Web Appendix A.

[8] Ambrose et al. (2002) study the opposite type of leases; in other words, leases with rents that adjust only in the upward direction.
[9] The lessor's use of alternative lease types does not change our proof because lease values for alternative leases are equalized at any time under the lessor's consistent pricing condition.

In the consistent pricing condition, $\sum_{t=0}^{T-2} \mathrm{E}_0\left[\left(\hat{Y}_t^T - \hat{Y}_t^{T-1}\right) m_t\right] + \mathrm{E}_0\left[\left(\hat{Y}_{T-1}^T - \hat{Y}_{T-1}^{T-1}\right) m_{T-1}\right] = 0$, the second term is negative because the lemma implies a lower expected rents for the T strategy than for the $T-1$ strategy during the final period. To satisfy the condition, the former strategy must generate higher expected rents than the latter strategy before this final period. For this reason, the initial rent for the T-period lease must be set higher than the initial rent of the $T-1$-period lease. Formally, using the above lemma, we obtain the key proposition of this study:

Proposition: *Under the condition of the lessor's consistent pricing, the rent term structure is upward sloping in a frictionless market if the lessee can terminate a lease at any time before the maturity of the lease.* $\left(i.e., \hat{R}_0^u > \hat{R}_0^{u-1}\ for\ any\ lease\ term\ u = 2, \dots, T\right)$

Proof: See Web Appendix A.

This result holds regardless of the lessor's risk aversion or the correlation between the short-term rent and the discount factor.

The Term Structure in the Presence of Leasing Costs

We next introduce lessor's leasing costs. On one hand, the embedded cancellation option produces an upward-sloping term structure as we demonstrate in the previous subsection. On the other hand, the lessor's leasing costs should produce a downward-sloping term structure because the initial short-term rent must compensate for a larger cost due to more frequent renewal. The net effect of these two competing factors depends on the specifics of leasing costs and the short-term rent process. We demonstrate that lease rates exhibit a U-shaped term structure when we make reasonable assumptions about leasing costs and a short-term rent process.

Consider the T and $T-1$ leasing strategies in a two period setting. The initial lease for the $T-1$ strategy is a one-period lease with rent R_0^1, which will expire without cancellation. Then, the lessor will pay leasing cost C and arrange a one-period lease; i.e., the second period income is $\hat{Y}_1^{T-1} = R_1^1 -$

C. For the T strategy, the initial two-period lease with rent $\hat{R}_0^2$ can be cancelled in a low rent case $\left(R_1^1 < \hat{R}_0^2\right)$. Then, the lessor's income will be $\hat{Y}_1^T = R_1^1 - C$. Alternatively, in a high-rent case, the lessor will receive the initial rent: $\hat{Y}_1^T = \hat{R}_0^2$. The consistency condition between these two strategies is: $R_0^1 + \mathrm{E}_0[(R_1^1 - C)m_1] = \hat{R}_0^2 + \mathrm{E}_0\left[\hat{Y}_1^T m_1\right]$. This equation implies that the initial rent term premium depends on the expected net income gap in the final period: $\hat{R}_0^2 - R_0^1 = \mathrm{E}_0\left[\left(R_1^1 - C - \hat{Y}_1^T\right)m_1\right]$. Since the rental income is identical for both strategies in the low-rent case, the term premium is determined by the expected rent gap in the high-rent case; $\mathrm{E}_0\left[R_1^1 - C - \hat{R}_0^2 \middle| R_1^1 \geq \hat{R}_0^2\right]$.

In general, the sign of the T-period term premium critically depends on the expected net income gap in the high-rent case during the final period:[10]

(4) $\mathrm{E}_0\left[R_{T-1}^1 - C - \hat{R}_0^T | \text{the high rent case}\right]$,

where the high-rent case is defined by both no cancellation of the T-1 period lease and $R_{T-1}^1 \geq \hat{R}_0^T$. If the leasing cost is a constant amount, Eq. (4) becomes $\mathrm{E}_0[R_{T-1}^1 | \text{the high rent case}] - C - \hat{R}_0^T$. Alternatively, if the leasing cost is proportional to the new rent (i.e., $C = cR_{T-1}^1,\ c \in (0,1)$), then Eq. (4) becomes $(1-c)\mathrm{E}_0[R_{T-1}^1 | \text{the high rent case}] - \hat{R}_0^T$. In both cases, the conditional expectation of the short-term rent is greater for a larger T when R_t^1 is a diffusion process. For example, if the short-term rent is a random walk, both its standard deviation and conditional mean value are proportional to $\sqrt{T}$. Thus, for sufficiently large leasing costs, the expected net income gap in the final period is negative for shorter lease terms and positive for longer lease terms. This implies that the lease term premium is negative (i.e., downward-term structure) for shorter lease terms and positive (i.e., upward-term structure) for longer lease terms.

[10] The rent term premium is also affected by the expected net rent gap prior to the final period. We take into account the total rent gap in our numerical exercise.

Numerical Analysis

We numerically analyze the term structure by parameterizing the risk-free rate, rent volatility, the risk premium on the short-term rent, the expected rent growth, and most importantly, leasing costs. We generate 1,000 paths of short-term lease rates and compute the landlord's rental income for each rent path because the cancellation option is a path-dependent option. The simulation detail is explained in Web Appendix B. Figure 2 presents the simulated term structure of cancellable lease rates when there is no leasing cost. All panels demonstrate upward-sloping term structures, and hence confirm the Proposition. Panel A presents the effects of rent volatility. Greater rent volatility makes the slope steeper because the tenant's cancellation option becomes more valuable. Panel B presents the effects of the risk-free rate. A higher risk-free rate makes the slope flatter because future rent differences have smaller impacts on the present value. However, this effect is not large. Panel C presents the effects of the risk premium on short-term rents. A larger risk premium on the short-term rent also makes the slope flatter because it makes long-term leases relatively less risky. Panel D presents the effect of the expected rent growth. A higher expected future rent naturally makes the slope steeper just as the expectation hypothesis implies.

=== Figure 2 around here ===

Figure 3 depicts the simulated term structure when a proportional leasing cost is introduced. An upward-sloping term structure is maintained when leasing costs are smaller than approximately 10%, which corresponds to 36-day vacancies per year or a $2,000 cost of contracting for a $20,000 annual rental income. With larger leasing costs, the lease rate demonstrates a U-shaped term structure. Therefore, our model predicts an upward-sloping term structure for a market with a small leasing cost and a U-shaped term structure for a market with a moderately large leasing cost.

=== Figure 3 around here ===

Discussions on the Equilibrium Rent Function

The consistent pricing condition primarily describes a lessor's asking rent for a given level of wealth and utility. However, under some conditions, this asking rent also describes the representative lessor's pricing and thus characterizes the market equilibrium rent. First, when lessors are homogeneous, an individual lessor's asking rent is equivalent to the representative lessor's asking rent. Then, regardless of whether lessees are homogeneous or not, lease contracts are always made on the asking rent curve. Second, when markets are complete (or at least quasi complete) in the sense that all idiosyncratic risks are perfectly insured, the stochastic discount factor depends only on the aggregate wealth and thus common to all lessors and lessees. Then, the value of a cancellation option is uniquely determined. In this case, the consistent pricing condition characterizes the market equilibrium rent. Third, when Rubinstein's (1974) aggregation condition holds with respect to the common cautiousness, the wealth distribution in the economy does not affect the utility of the representative agent. Then, an individual lessor's consistent pricing condition describes the representative lessor's pricing and thus characterizes the market equilibrium rent.

Alternatively, lessors' heterogeneity can leads to a separating equilibrium such as the hedonic equilibrium formalized by Rosen (1974). In a hedonic equilibrium, the price function for an attribute is characterized by the envelope of heterogeneous lessors' offer functions and the envelope of heterogeneous lessees' bid functions. In particular, the envelope of individual offer functions with respect to lease term defines the equilibrium term structure. Although the exact shape of the envelope depends on the specifics of preferences and lessors' heterogeneity, when all lessors' offer functions are upward-sloping, the envelope is also upward-sloping. When all lessors' offer curves are convex functions, their envelope is also likely to be a convex function with smaller curvature.

In our model, individual lessors' offer functions are upward-sloping when there is no leasing cost and U-shaped when there are leasing costs. However, individual lessees' bid functions always slope upward if a lessee can choose between short- and long-term leases because a lessee is never willing to pay a higher rent for a short-term lease than for a cancellable long-term lease. Thus, when there is no leasing cost, the hedonic equilibrium rent function slopes upward because both bid and offer functions slope upward. However, when there are leasing costs, the envelope of upward-sloping bid functions would partially diverge from the envelope of U-shaped offer functions in the downward-sloping region. In this case, no transaction would occur in the region where asking and bid functions diverge (i.e., the downward-sloping part of the term structure) unless markets are segmented.

Markets are segmented if a part of lessees do not have access to all lease types and form their bid functions only for a limited range of lease terms. An example is when no long-term lease is offered to low-credit lessees. Then, low-credit lessees need to accept the lessor's short-term asking rent because there is no alternative lease to compare with. In this case, the U-shaped offer function under leasing costs characterizes the equilibrium rent function. However, we would observe only a small number of short-term lease contracts by low-credit lessees. An important implication of this equilibrium is that a high short-term rent does not indicate exploitation of low-credit lessees but rather a compensation for high leasing costs.

When a lessee's quality is private information, there could be an alternative equilibrium that features positive term premiums without reliance on a cancellation option. If the lessor is unsure about the lessee's quality when offering leases, the lessor may be willing to accept a lower rent for a shorter-term lease. This is because the lessor can stop renewing a short-term lease when the lessee's quality turns out to be low. From a lessee's perspective, a low-quality lessee would prefer a long-term lease because a short-term lease would not be renewed. An equilibrium can be either separating or pooling. In a separating equilibrium, low-quality lessees select long-term leases and high-quality lessees select short-term leases even though the lessor demands an extra long-term rent premium to low-quality lessees. In this case, we would observe increasing rents and decreasing lessee quality with respect to lease term. In a pooling equilibrium, we would still observe a rent term premium but no systematic pattern in the lessee quality. In our empirical analysis, we sort out the option-based and information-based stories on the basis of the distribution of lessees' quality.

Calibration to Japanese Data

We calibrate our model to Japanese residential lease data and derive predictions about the lease term structure for our empirical analysis. Details of these parameter values are presented in Web Appendix C. Figure 4 presents our predictions about the Japanese lease term structure. In Panel A, which depicts the prediction for the low-vacancy area, the slope is positive for the entire range of lease terms, reflecting the value of cancellation options. On the basis of the average period of residence under general lease, we treat the 8-year rate as the general lease rate. In Panel B, which depicts the prediction for the high-vacancy area, a U-shaped term structure is obtained. The negative slope at the short end of the term structure (for 1- and 2-year leases) is a result of incorporating large vacancy costs. The rent is lowest for 3- or 4-year leases. At the long end of the term structure (for longer-term and general leases), the slope is positive as a result of incorporating cancellation options. The general lease rate lies between the short- and medium-term rates. In the downward-sloping part of the term structure, the tenant credit quality is expected to be lower due to market segmentation. From this result, we obtain the following qualitative predictions for residential lease rates in Japan:

Predictions*:*

1. In the low-vacancy area, the short-term lease rate is lower than the general lease rate and the term structure is upward-sloping.

2. In the high-vacancy area, the short-term lease rate is higher than the general lease rate and the term structure is U-shaped.

3. Short-term leases in the high-vacancy area are used by low-credit tenants.

=== Figure 4 around here ===

Data

We empirically estimate the term structure of cancellable lease rates by using the Japanese residential lease data. The Japanese market is ideal for this study because cancellation options are legally granted to tenants in all lease contracts. Specifically, the tenant can terminate a lease contract without a penalty at any time with one to three months' notice. Another benefit of using the Japanese residential data is that a wide range of lease terms are observed. A general lease contract, which has been traditionally used, is effectively an open-ended, long-term, fixed-rate lease contract. Under the current JTPL, landlords can also offer fixed-term lease contracts, which typically range from one to ten years.

The data are drawn from the Keio Household Panel Survey (KHPS) and the Japan Household Panel Survey (JHPS), which are sponsored by the Japanese Ministry of Education, Culture, Sports, Science and Technology and are conducted by faculties of Economics, and Business and Commerce of Keio University. The first wave of the KHPS was conducted in January 2004 and examined 4,005 households that were selected through stratified two-stage sampling. Although the KHPS restricted its respondents to individuals who were between 20 and 69 years of age during the first wave of the survey, the demographic characteristics of the survey responses are representative of Japanese households. In particular, the majority of the sample is composed of homeowners (the national homeownership rate is 62.1% in 2005). Beginning in 2009, the JHPS expanded the KHPS sample. The first wave of the JHPS was conducted in January 2009 and gathered data from 4,000 Japanese households. Because both of these surveys share many common items, we can augment the KHPS results with the JHPS results.

Drawing on eight waves of the KHPS and three waves of the JHPS, we construct a sample of renters who moved into rental units after March 2000. Since 2000, the amended JTPL has allowed the use of fixed-term leases. For each renter, we gather the following variables: type of lease contract, lease term, move-in year, monthly rent, deposit, building age, number of rooms, travel time to the nearest public transportation, building type, and residence location. Each wave contains the information from individuals who moved during the previous year. The second wave of the KHPS contains additional information for previous housing tenures that occurred between 2000 and 2002. The share of renters with fixed-term leases is 4% in the original sample, which is consistent with the national statistics. After the deletion of homeowners and incomplete observations, the size of our renter sample becomes 702. The final sample contains 495 observations for general leases and 207 observations for fixed-term leases.

Descriptive Statistics

Table 1 summarizes the property characteristics of the examined general leases and fixed-term leases. We also present the characteristics of owner-occupied housing after March 2000 for comparison. Leased properties, which are mainly reinforced concrete structures, are smaller and older than owner-occupied housing. This is a well-documented fact by the existing studies (e.g., Seko and Sumita, 2007). Within our fixed-term leases sample, the average lease term is 2.8 years, and 95% of lease terms are five years or less.[11] The general and fixed-term lease samples exhibit reasonably similar characteristics.[12] For example, two samples are similar in the average ages of the housing units (16 years), the average vacancy rate (18%), the number of rooms (3 rooms), the distribution of the type of dwelling, the time to the nearest station (9 minutes), the share of major cities (40%) and other

[11] We use lease contracts that are shorter than or equal to five years because the number of leases longer than five years is small and their tenant characteristics are significantly different from the average characteristics.
[12] In Web Appendix D, we present the result of additional tests by probit regressions.

cities (55%), and the distribution of contracting years. For both types of leases, the major type of dwelling is a reinforced concrete apartment building. However, the share of fixed-term leases is slightly higher in Kanto region, which includes Tokyo. In Kanto region, landlords have adopted the new form of lease contract more quickly perhaps because there is greater demand for shorter-term leases in Tokyo. In our empirical analysis, we use hedonic regressions to control for these property characteristics.

=== Table 1 around here ===

Table 2 presents the tenant characteristics of the examined general leases and fixed-term leases in the high-vacancy area (Panels A) and the low-vacancy area (Panel B). We also present the homeowner characteristics for comparison. In Panel C, we present the test result of equal means between high- and low-vacancy areas. Several notable patterns are observed. First, homeowner characteristics are relatively similar between low and high vacancy areas. For example, mean differences between two areas are 0.37 years for age, 0 percentage points for the proportion of full-time employees, 1 percentage point for the proportion of female household head, and 50 thousand yen for financial asset. This is not surprising because two areas are categorized by vacancy rates for rental units rather than owner-occupied units.

Second, the variation in renter characteristics between two lease types is significantly smaller than the variation between average renters and homeowners.[13] The average renter is generally less creditworthy than the average homeowner. For example, the homeowner's average financial asset in both areas is 8.67 million yen while the tenant's average asset is 3.40 million yen for general leases and 3.30 million yen for fixed-term leases. The same pattern is observed for the annual income. Renters are also more likely to be young, single, female, non-full-time employees. At the same time, renters are more likely to be college graduates and plan to purchase a house within five years. Because

[13] In Web Appendix D, we present the result of additional tests by probit regressions.

general and fixed-term lease samples are similar to each other in property and tenant characteristics, the market is unlikely segmented by lease type.

Third, renter variation between high- and low-vacancy areas is larger than owner variation. Renters are generally more creditworthy in the low-vacancy area for both lease types; e.g., annual income is 25.0% higher, financial asset is 80.0% larger, and the proportion of college graduates is 9.4 percentage points higher. These differences are statistically significant at least at the 5% level. The proportion of female household head is also 9.5 percentage points lower in the low-vacancy area although this variable does not necessarily indicate creditworthiness. The higher quality of tenants in the low-vacancy area probably reflects a better economic condition in the area.

In summary, the average characteristics of leased properties and tenants are markedly different from the characteristics of owner-occupied properties and owners. However, within the lease sample, average property and tenant characteristics are reasonably similar for both lease types except that fixed-term leases are more commonly used in Kanto region. Tenant characteristics vary more significantly by market vacancy rate; e.g., tenants tend to be more creditworthy in the low-vacancy area.

=== Table 2 around here ===

Calculating Predictive Errors

To test our prediction, we compute the relative rent of fixed term leases compared with general lease rents.[14] Specifically, we first divide the general lease sample into high- and low-vacancy areas and estimate a hedonic model for each area. The market vacancy rate represents the lessor's leasing costs. The high- and low-vacancy areas are defined on the basis of the market vacancy rate relative

[14] This empirical strategy is equivalent to pooling both types of leases and including interaction terms with a fixed-lease dummy by treating general leases as a reference group.

to the national average.[15] The market vacancy rates are calculated for all prefectures and 18 major cities using the National Housing and Land Survey in 2003 and 2008. The explanatory variables describe housing characteristics, which consist of the number of rooms that are being rented, the age of the building in which the tenant resides, the type of dwelling that is occupied by the tenant, and the time that is required to travel to the nearest train station or bus stop. We also include year and region fixed effects. The result of general lease regressions is presented in Table 3. Second, using the estimated model for each area, we generate an out-of-sample prediction of rents for the sample of fixed-term leases. The predicted value for a rental unit represents the hypothetical rent that would be obtained if the rental unit in question were leased under a general lease contract. The predictive error is calculated by subtracting this predicted value from the actual fixed-term lease rate.

=== Table 3 around here ===

Empirical Results

The Empirical Model

We first estimate the following equation using fixed-term leases in all areas:

(5) $perror_{it} = \alpha + \beta L'_{it} + \gamma X'_{it} + \varepsilon_{it}$,

where the dependent variable $perror_{it}$ is the predictive error of a fixed-term lease rate for tenant i at time t and ε_{it} is the model's stochastic error term. This predictive error is calculated as defined in Data Section. A vector X'_{it} is property characteristics and fixed effects that are the same as in the general lease regression. The coefficient γ captures the difference in coefficient between the general and fixed-term leases. A vector L_{it} is lease term dummy variables and a vector of coefficients

[15] The average of the 2003 and 2008 national vacancy rates is 19% if it is adjusted for rotten structures.

β captures the nonlinear relation between predictive error and lease term. Using one-year leases as the reference group, we include four dummy variables in L_{it}.

We also estimate the rent term structure separately for high- and low-vacancy areas by including the interaction terms of the lease term dummies and a dummy variable for the high-vacancy area:

(6) $perror_{it} = \alpha + \beta L'_{it} + \delta L'_{it} \times h_{it} + \theta h_{it} + \gamma X'_{it} + \varepsilon_{it}$,

where h_{it} is a dummy variable for the high-vacancy area. Although the actual rent term structure could vary by local market within each vacancy area, we cannot estimate the term structure for each local market due to a limited number of observations. Since our estimated term structure is the average for each vacancy area, standard errors could be relatively large. We estimate several variations with respect to the control variables by the ordinary least squares (OLS).

Note that we do not control for tenant characteristics because the identification of the hedonic rent function requires transactions by heterogeneous lessors and lessees. It is not recommended to partially and arbitrarily control for tenants' characteristics unless they proxy for an unobserved attribute of housing units. In our sample, the estimated coefficients on the lease term dummies are not significantly affected by the inclusion of tenant characteristics; i.e., tenant characteristics do not cause omitted-variable bias.

The Estimation Results

Table 4 presents the estimation results. Model (a) corresponds to Eq. (5). The estimated coefficients on lease term dummies are negative for 2 years and longer, with the smallest value on the 2-year dummy (−0.294) and the largest value on the 5-year dummy (−0.015). We observe a U-shaped structure that is similar to our theoretical prediction for the 20% cost case in Figure 3. The difference between coefficients on the 1-year and 2-year dummies (0.294) is marginally significant with the p-value of 0.104, and the difference between coefficients on the 2-year and 5-year dummies (-0.279) is significant at the 10% level.

=== Table 4 around here ===

Models (b) through (e) are variations of Eq. (6). In Model (b), we exclude all control variables and fixed effects by assuming that the hedonic coefficients on the excluded variables are identical between general and fixed-term leases. This model gives the maximum value of the residual degrees of freedom. We include property characteristics in Model (c) and year and region fixed effects in Model (d) because some of the characteristics may be correlated with lease terms. In Model (e), we include both control variables and fixed effects.

The estimated coefficients are consistent across four variations. First, the coefficients on lease terms are positive and generally increasing, which indicates a mildly upward-sloping term structure of fixed-term lease rates in the low-vacancy area. This finding is consistent with our theoretical prediction in Model Section. The difference between 1- and 5-year rents is economically significant. For example, based on Model (e), the gap between 1-year and 5-year rates is 256 yen (approximately \$2.46) per month per square meter, or 12,800 yen (approximately \$123.21) per month for a standard 50 m^2 unit. In Model (d), the difference is almost twice as large. However, most of these coefficients are not statistically significant. As we anticipate, standard errors are large probably because there is variation in term structure by local markets. We also find that the estimated coefficients become slightly smaller as we include more control variables and fixed effects. Thus, lease terms are weakly correlated with the difference in property characteristics between general and fixed-term leases.

The coefficient on the high-vacancy area dummy is large and statistically significant at the 1% level in all specifications. For example, the point estimate is 0.738 in Model (e). The coefficients on the interaction terms between lease terms and the high-vacancy area dummy are all negative and statistically significant at least at the 5% level. These results indicate that the term structures are significantly different between the low- and high-vacancy areas. Specifically, in the high-vacancy area, the short-term rent is significantly higher and the medium-term rent is lower than the 1-year reference rent in the low-vacancy area. In other words, a U-shaped term structure is observed in the high-vacancy area. By the most conservative estimate in Model (e), the rent difference between 1- and 2-year leases is -0.897 and statistically significant at the 1% level, and the difference between 2- and 5-year leases is 0.349 and significant at the 10% level. This finding is consistent with our prediction in Model Section. These results are also robust when we estimate Eq. (6) by the least absolute deviation method or by using log-transformed rents (this report is omitted).

Figure 5 depicts the rent term structure for the low-vacancy (Panel A) and high-vacancy areas (Panel B) based on Model (e).[16] The fixed-term rent relative to the general lease rent (i.e., predictive error) is evaluated for the medium-sized cities at the mean value of numeric variables and the mode of the dummy variables.[17] The value of zero for general lease represents the long-term lease rate. These two panels are remarkably consistent with the theoretical predictions depicted in Figure 4. In the low-vacancy area, as the lease term increases, the relative rent increases from a negative value to approximately zero. In the high-vacancy area, the short-term rent is significantly higher and the medium-term rents are lower than the general lease rent.

=== Figure 5 around here ===

An alternative explanation of this variation by market vacancy rate is that future rents are expected to decrease in the area with a high vacancy rate and they are expected to increase in the area with a low vacancy rate. This can be a good explanation in a cyclical market in which rents and vacancy rates widely fluctuate over time. However, this is not a good explanation for Japanese rental housing market. The market vacancy rate is extremely persistent and non-cyclical in Japan; i.e., an

[16] The estimated term structures exhibit the same shapes based on Models (b), (c), or (d).
[17] The mean values are 16.4 and 15.1 years for building age, 9.5 and 9.8 minutes for the time to the nearest station in low- and high-vacancy areas, respectively.

area with a high vacancy rate is likely to maintain the high vacancy rate even after a decade. At the prefecture level, Spearman's rank correlation coefficient between the 2003 vacancy rate and the 2008 vacancy rate is 0.85, and the coefficient between the 1998 vacancy rate and the 2008 vacancy rate is 0.65. Thus, the cross-regional variation in vacancy rates probably reflects the variation in the natural rate of vacancy.

Our additional prediction in Model Section is that the tenant quality is low in the short-term lease sample when leasing costs are high. In contrast, if asymmetric information about tenant quality is the fundamental factor, we would rather observe high quality tenants in the short-term lease sample and low quality tenants in the long-term lease sample. First, on the basis of tenant characteristics presented in Table 2, we do not find evidence supporting the asymmetric information hypothesis that low quality tenants select long-term leases. The medium-term lease and general lease tenants are qualitatively similar in both high- and low-vacancy areas. Second, we confirm that our market segmentation hypothesis is consistent with the data. Table 5 presents the tenant characteristics for 1-year and medium-term leases in the high-vacancy area. The 1-year lease tenants in the high-vacancy area are characterized by lower income, smaller financial assets, younger age, female household head, lower education, and being married than medium-term lease tenants. In particular, differences are statistically significant for financial asset, age, and the proportion of college graduate. Moreover, differences are economically significant for most variables; e.g., the real annual income is approximately 20% lower, the real financial asset is 70% smaller, and the age is 10 years younger. These characteristics of 1-year tenants are observed only in the high vacancy area. Therefore, the observed U-shaped rent term structure is consistent with the theory based on cancellation options and leasing costs.

=== Table 5 around here ===

Conclusion

The rent term structure is generally considered to be a reflection of expected future rents and risk premium. An upward-sloping structure is often interpreted as indicative of the prospect of collecting increasing rents in the future in accordance with the expectation hypothesis. However, we prove that an upward-sloping term structure does not necessarily imply increasing future rents or riskiness of cancellable leases when leasing costs are small. Moreover, when we introduce large leasing costs such as vacancy costs, cancellable leases demonstrate a U-shaped term structure even if the short-term rent stays constant over time. We report that the Japanese residential lease rates are remarkably consistent with this theory. These results suggest that interpreting a term structure requires great care with respect to the embedded options, contracting costs, and market vacancy rates.

Overall, this study contributes to the literature by providing a new insight into the lessor's optimal choice of rents and the interpretation of the equilibrium rent term premium. Given the importance of cancellable leases, future studies should address the term structures of other cancellable lease contracts such as operating leases, commercial real estate leases, and residential leases in European countries.

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Table 1
Property Characteristics

Variables	(a) Fixed-term lease		(b) General lease		(a)-(b)	(c) Owner-occupied	
	Mean	Std. Dev.	Mean	Std. Dev.	P-value	Mean	Std. Dev.
Real price per square meter						316.30	237.16
Real monthly rent per square meter	1.72	0.82	1.52	0.87	0.00		
Predictive error	0.046	0.657					
Unit size (m^2)	50.8	45.4	55.2	47.4	0.24	127.01	153.72
Deposit: multiple of monthly rent (in months)	1.9	1.0	2.5	1.9	0.00		
Average vcancy rate between 2003- 2008(%)	17.97	3.42	18.16	3.23	0.50	18.57	3.18
Lease term (in years)	2.8	1.0					
Building age (in years)	15.5	10.2	16.2	11.0	0.42	9.96	9.89
Number of rooms	3.1	1.2	3.3	1.2	0.03	5.66	17.26
Type of dwelling							
Detached house	0.09	0.28	0.13	0.34	0.07	0.84	0.37
Townhouse	0.04	0.19	0.04	0.20	0.91	0.00	0.04
Apartment, reinforced concrete structure	0.57	0.50	0.61	0.49	0.30	0.16	0.37
Apartment, wooden structure	0.30	0.46	0.22	0.41	0.02	0.00	0.00
Other type	0.01	0.10	0.00	0.06	0.45	0.00	0.04
Time to the nearest station	8.99	7.32	8.65	8.31	0.59	9.72	9.08
Location characteristics							
Non-urban areas	0.04	0.19	0.07	0.25	0.09		
Major cities	0.37	0.48	0.39	0.49	0.69	0.29	0.45
Other cities	0.59	0.49	0.54	0.50	0.26	0.61	0.49
Regions							
Hokkaido	0.03	0.17	0.03	0.17	0.93	0.04	0.19
Tohoku	0.04	0.20	0.06	0.23	0.46	0.05	0.21
Kanto	0.57	0.50	0.38	0.49	0.00	0.36	0.48
Chubu	0.12	0.33	0.13	0.33	0.81	0.15	0.36
Kinki	0.10	0.30	0.18	0.38	0.00	0.23	0.42
Chugoku	0.07	0.26	0.06	0.24	0.51	0.04	0.19
Shikoku	0.03	0.17	0.02	0.15	0.73	0.04	0.19
Kyushu	0.04	0.20	0.14	0.35	0.00	0.10	0.30
Contracting year							
2000	0.07	0.26	0.08	0.28	0.64	0.15	0.36
2001	0.09	0.29	0.08	0.28	0.77	0.12	0.33
2002	0.08	0.28	0.09	0.28	0.84	0.12	0.33
2003	0.08	0.28	0.09	0.28	0.84	0.15	0.36
2004	0.12	0.33	0.13	0.33	0.87	0.12	0.32
2005	0.09	0.28	0.09	0.29	0.80	0.10	0.30
2006	0.10	0.30	0.13	0.34	0.20	0.08	0.28
2007	0.12	0.32	0.10	0.30	0.57	0.07	0.25
2008	0.15	0.36	0.12	0.32	0.23	0.06	0.23
2009	0.07	0.26	0.06	0.24	0.57	0.03	0.16
2010	0.03	0.17	0.03	0.18	0.71	0.01	0.08
Number of observations	207		495			5275	

Notes: The real housing price, rent and predictive error are expressed in thousand yen at the 2010 price levels. The sample period is between March 2000 and December 2010.The group mean comparison represents the p-value for a paired t-test of equal means between two samples. This test uses Welch's method under the hypothesis of heteroskedasticity.

Table 2
Tenant characteristics

Panel A: High vacancy area

	(a) Fixed-term lease			(b) General lease			(a)-(b)	Owner-occupied housing		
Variables	n	Mean	Std.Dev.	n	Mean	Std.Dev.	p-value	n	Mean	Std.Dev.
Real annual income	79	4.84	3.14	204	4.30	2.58	0.18	2,369	6.85	3.88
Real financial asset	47	2.15	3.31	130	2.41	4.37	0.67	1,408	8.65	14.81
Full-time employee	82	0.57	0.50	222	0.59	0.49	0.85	2,479	0.71	0.46
Age	81	36.74	12.27	220	38.26	12.07	0.34	2,459	46.42	12.61
Female	82	0.28	0.45	220	0.25	0.43	0.60	2,466	0.08	0.27
College graduate	82	0.21	0.41	222	0.17	0.37	0.43	2,479	0.09	0.29
Married	82	0.28	0.45	222	0.31	0.46	0.66	2,479	0.46	0.50
Large firm employee	79	0.03	0.16	203	0.01	0.10	0.42	2,269	0.01	0.08
Have a home purchase plan	29	0.21	0.41	117	0.15	0.35	0.46	1,651	0.01	0.12

Panel B: Low vacancy area

	(a) Fixed-term lease			(b) General lease			(a)-(b)	Owner-occupied housing		
Variables	n	Mean	Std.Dev.	n	Mean	Std.Dev.	p-value	n	Mean	Std.Dev.
Real annual income	123	5.18	4.07	249	5.74	3.52	0.19	2,646	7.41	4.46
Real financial asset	66	4.12	11.79	150	4.25	8.79	0.94	1,527	8.69	16.41
Full-time employee	125	0.61	0.49	273	0.55	0.50	0.27	2,796	0.70	0.46
Age	125	36.54	11.63	272	39.51	12.51	0.02	2,778	46.79	12.29
Female	125	0.14	0.35	272	0.17	0.38	0.46	2,789	0.07	0.26
College graduate	125	0.25	0.43	273	0.28	0.45	0.47	2,796	0.12	0.33
Married	125	0.19	0.40	273	0.26	0.44	0.15	2,796	0.38	0.49
Large firm employee	113	0.05	0.23	258	0.03	0.18	0.45	2,546	0.01	0.08
Have a home purchase plan	55	0.16	0.37	122	0.20	0.40	0.59	1,685	0.02	0.14

Panel C: Difference between high- and low-vacancy areas

	Fixed-term lease		General lease		Owner-occupied housing	
Variables	difference	p-value	difference	p-value	difference	p-value
Real annual income	-0.34	0.50	-1.45	0.00	-0.56	0.00
Real financial asset	-1.98	0.20	-1.84	0.02	-0.05	0.94
Full-time employee	-0.03	0.62	0.04	0.42	0.00	0.89
Age	0.20	0.91	-1.25	0.26	-0.37	0.28
Female	0.14	0.02	0.08	0.04	0.01	0.45
College graduate	-0.04	0.49	-0.12	0.00	-0.03	0.00
Married	0.09	0.15	0.05	0.22	0.08	0.00
Large firm employee	-0.03	0.32	-0.03	0.06	0.00	0.74
Have a home purchase plan	0.04	0.64	-0.05	0.29	-0.01	0.26

Note: The real annual income and real financial asset are expressed in million yen at the 2010 price levels. Large firm is defined as a firm with 1,000 workers or more. The number of observations is denoted by n. The p-value is for a two-sided t-test for equal means between fixed-term and general leases (Panels A and B) and between high- and low-vacancy areas (Panel C).

Table 3
General lease rate regressions

	High-vacancy area			Low-vacancy area		
Independent variables	Coef.		Std. Err.	Coef.		Std. Err.
Building age (in years)	-0.016	***	0.003	-0.017	***	0.005
Number of rooms						
1 room	0.917	***	0.229	1.036	***	0.220
2 rooms	0.318	**	0.154	0.355	**	0.142
3 rooms		reference			reference	
4 rooms	-0.256	***	0.094	-0.140		0.119
5 rooms	-0.148		0.147	-0.727	***	0.196
over 6 rooms	-0.611	***	0.176	-0.204		0.237
Type of dwelling						
Detached house	0.123		0.147	0.258		0.169
Townhouse	-0.010		0.164	-0.105		0.174
Apartment, reinforced concrete structure		reference			reference	
Apartment, wooden structure	-0.055		0.122	0.089		0.120
Other type				0.215		0.221
Time to the nearest station	-0.004		0.004	0.005		0.010
Location characteristics						
Non-urban areas		reference			reference	
14 major cities	0.333	*	0.192	0.467	***	0.155
Other cities	0.062		0.161	-0.002		0.133
Deposit: multiple of monthly rent	0.008		0.011	-0.025		0.028
Constant	1.489	***	0.306	2.071	***	0.247
Regioal fixed effects		Yes			Yes	
Year fixed effects		Yes			Yes	
Adjusted R-squared	0.289			0.422		
Standard error of regression	0.587			0.718		
Number of observations	222			273		

Notes: The estimation results of a hedonic model for general leases. The dependent variable is monthly rent per square meter. The sample period is between March 2000 and December 2010. Heteroskedasticity-consistent standard errors are calculated. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4
Fixed-term lease regressions

Model	(a)	(b)	(c)	(d)	(e)
Lease term (in years)					
1 year (lease term ≤ 1)	reference	reference	reference	reference	reference
2 years (1 < lease term ≤ 2)	-0.294	0.161	0.107	0.033	0.010
	(0.181)	(0.180)	(0.180)	(0.199)	(0.199)
3 years (2 < lease term ≤ 3)	-0.106	0.259	0.179	0.207	0.135
	(0.176)	(0.174)	(0.177)	(0.186)	(0.187)
4 years (3 < lease term ≤ 4)	-0.193	0.148	0.087	0.091	0.061
	(0.202)	(0.261)	(0.265)	(0.284)	(0.286)
5 years (4 < lease term ≤ 5)	-0.015	0.490**	0.261	0.457*	0.256
	(0.218)	(0.231)	(0.245)	(0.263)	(0.279)
High-vacancy area dummy		1.065***	0.852***	0.918***	0.738***
		(0.227)	(0.238)	(0.280)	(0.263)
Interaction terms					
2 years ×High-vacancy area		-1.319***	-1.118***	-1.099***	-0.907***
		(0.268)	(0.281)	(0.325)	(0.314)
3 years ×High-vacancy area		-1.188***	-0.928***	-1.093***	-0.761***
		(0.271)	(0.277)	(0.315)	(0.288)
4 years ×High-vacancy area		-1.041***	-0.887**	-0.926**	-0.759**
		(0.363)	(0.363)	(0.392)	(0.376)
5 years ×High-vacancy area		-1.303***	-0.968**	-1.164***	-0.805**
		(0.357)	(0.375)	(0.384)	(0.355)
Building age (in years)	0.016***		0.016***		0.016***
	(0.005)		(0.005)		(0.005)
Deposit: multiple of	0.028		-0.026		0.012
monthly rent (in months)	(0.053)		(0.051)		(0.054)
Time to the nearest station	-0.009		-0.006		-0.008
	(0.005)		(0.006)		(0.005)
Number of rooms	Yes	No	Yes	No	Yes
Type of dwelling	Yes	No	Yes	No	Yes
Location characteristics	Yes	No	Yes	No	Yes
Regional fixed effects	Yes	No	No	Yes	Yes
Year fixed effects	Yes	No	No	Yes	Yes
Constant	0.685**	-0.127	0.288	0.182	0.431
	(0.271)	(0.144)	(0.226)	(0.224)	(0.271)
Adjusted R-squared	0.153	0.043	0.077	0.128	0.160
Number of observations	207	207	207	207	207
Degrees of freedom	170	197	183	180	166

Notes: Model (a) corresponds to Eq. (5), and models (b) through (e) correspond to Eq. (6). The dependent variable is predictive errors, which represents the relative rent of a fixed-term lease rate relative to a comparable general lease rate, as defined in Data Section. The sample period is between March 2000 and December 2010. Heteroskedasticity-consistent standard errors are calculated. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5
Fixed-term lease tenant characteristics in the high vacancy area

	Fixed-term lease						
	(a)1 year			(b) 2-5 years			(a)-(b)
Variables	n	Mean	Std. Dev.	n	Mean	Std. Dev.	P-value
Real annual income	5	3.95	2.64	74	4.90	3.18	0.48
Real financial asset	5	0.71	0.61	42	2.32	3.46	0.01
Full-time employee	5	0.60	0.55	77	0.57	0.50	0.91
Age	5	27.40	5.41	76	37.36	12.37	0.01
Female	5	0.40	0.55	77	0.27	0.45	0.63
College graduate	5	0.00	0.00	77	0.22	0.42	0.00
Married	5	0.40	0.55	77	0.27	0.45	0.63
Large firm employee	5	0.00	0.00	74	0.03	0.16	0.16

Note: The real annual income and real financial asset are expressed in million yen at the 2010 price levels. Large firm is defined as a firm with 1,000 workers or more. The number of observations is denoted by n. The p-value for (a)-(b) is for a two-sided t-test for equal means between 1 year leases and longer-term leases.

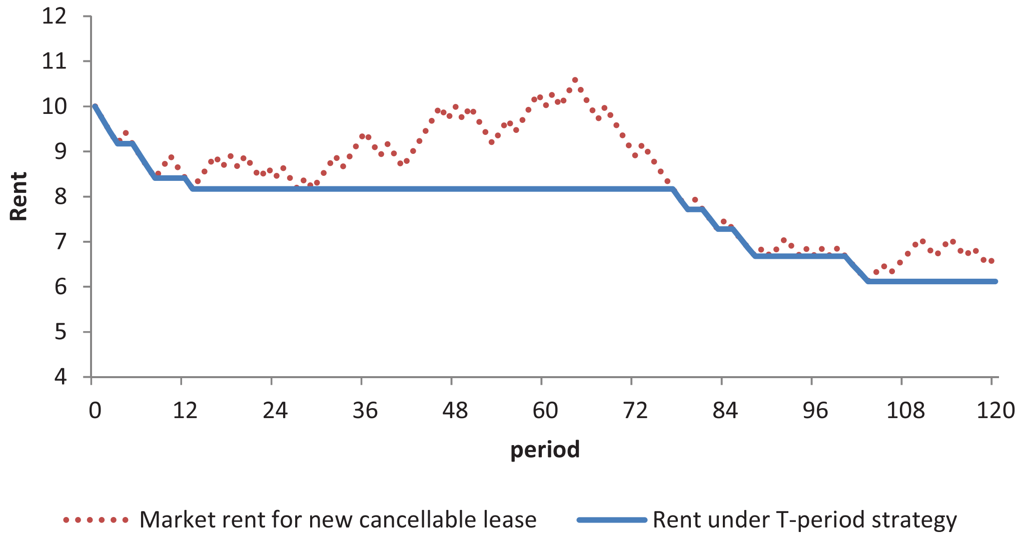


Figure 1
A sample path of the market rent and the rent under the T strategy
This figure presents a sample path of the market rent $\widehat{R}_t^{T-t}$ and the rental income for the T strategy $\widehat{\mathrm{Y}}_\mathrm{t}^\mathrm{T}$, as characterized in Eq. (3) in Model Section. The market rent is generated through the use of a ten-year monthly binomial tree with constant volatility. The initial rent $\widehat{R}_0^T$ is 20 and its volatility is 10% per year. The rent for the T strategy, which is determined recursively by the rule, $\widehat{\mathrm{Y}}_\mathrm{t}^T = \min\{\widehat{Y}_{t-1}^T, \widehat{R}_t^{T-t}\}$ for $t = 1, \ldots, \mathrm{T} - 1$, always traces the historical minimum of the market rent.

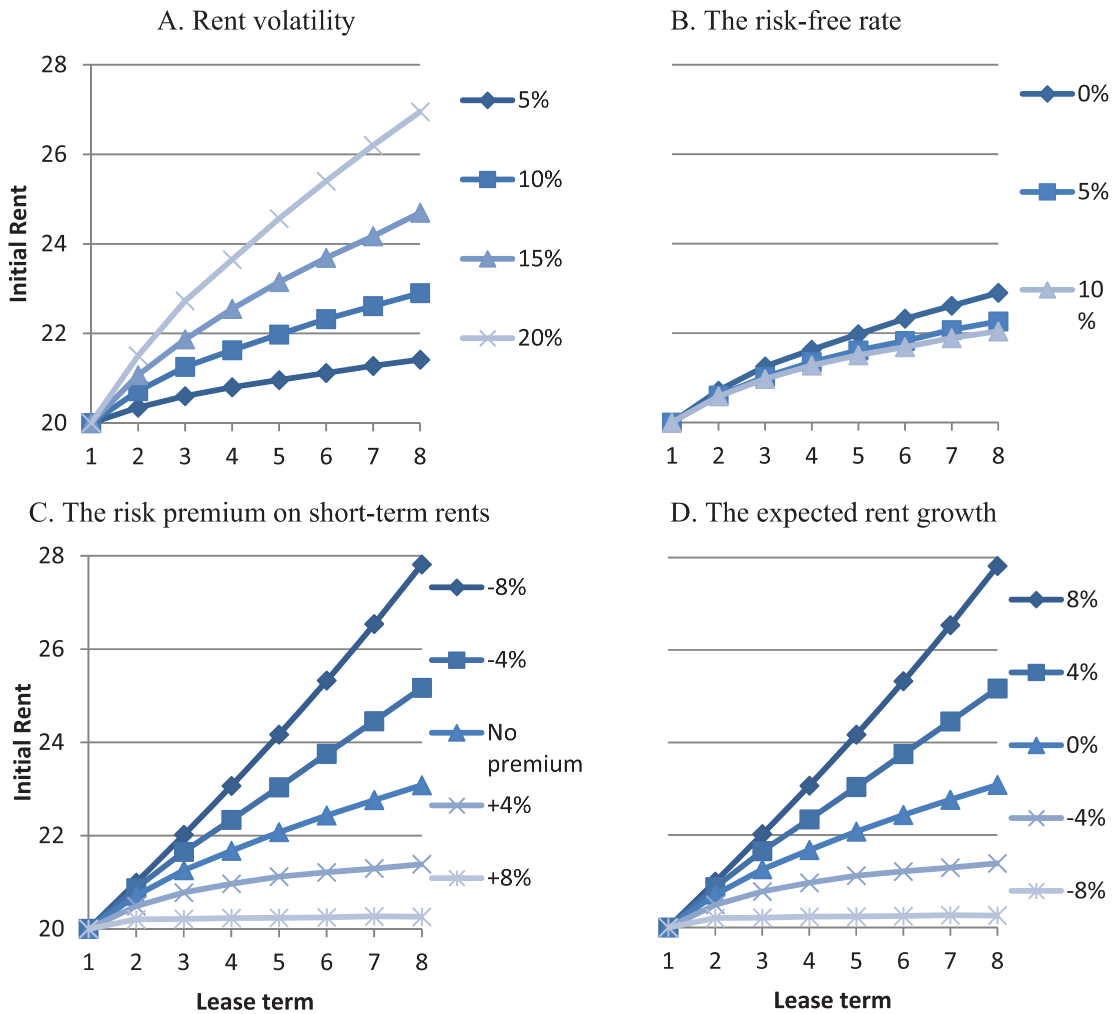


Figure 2

Simulated term structure of cancellable lease rates without leasing costs

This figure presents the result of simulations described in Model Section. For each set of parameter values, the initial rent of a cancellable lease is determined such that the lease present value is equalized to the present value of a roll-over short-term lease. Panels A through D depict the effects of rent volatility (A), the risk-free rate (B), the risk premium on short-term rents (C), and the expected rent growth (D), respectively. The base parameter values are as follows: The initial short-term rent is 20, the rent volatility is 10% per period, the risk-free rate is 0%, the risk-premium is 0%, the expected rent growth is 0%, and contracting costs are zero.

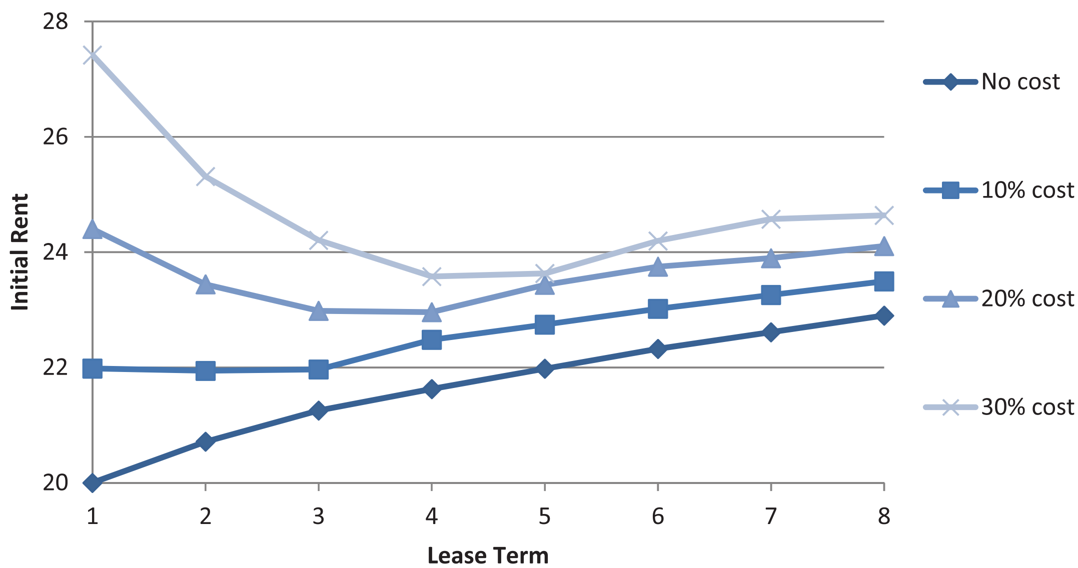


Figure 3
Simulated term structure of cancellable leases with leasing costs
This figure presents the effects of lessor's leasing costs such as vacancy costs. Four lines represent the initial rent term structures for alternative cost assumptions of 0%, 10%, 20%, and 30%, respectively. The initial rent for each lease term is determined such that the present value of the leasing strategy is equal to the benchmark present value of a roll-over short-term lease with no leasing cost. The base parameter values are as follows: The rent volatility is 10% per period, the risk-free rate is 0%, the risk-premium is 0%, and the expected rent growth is 0%.

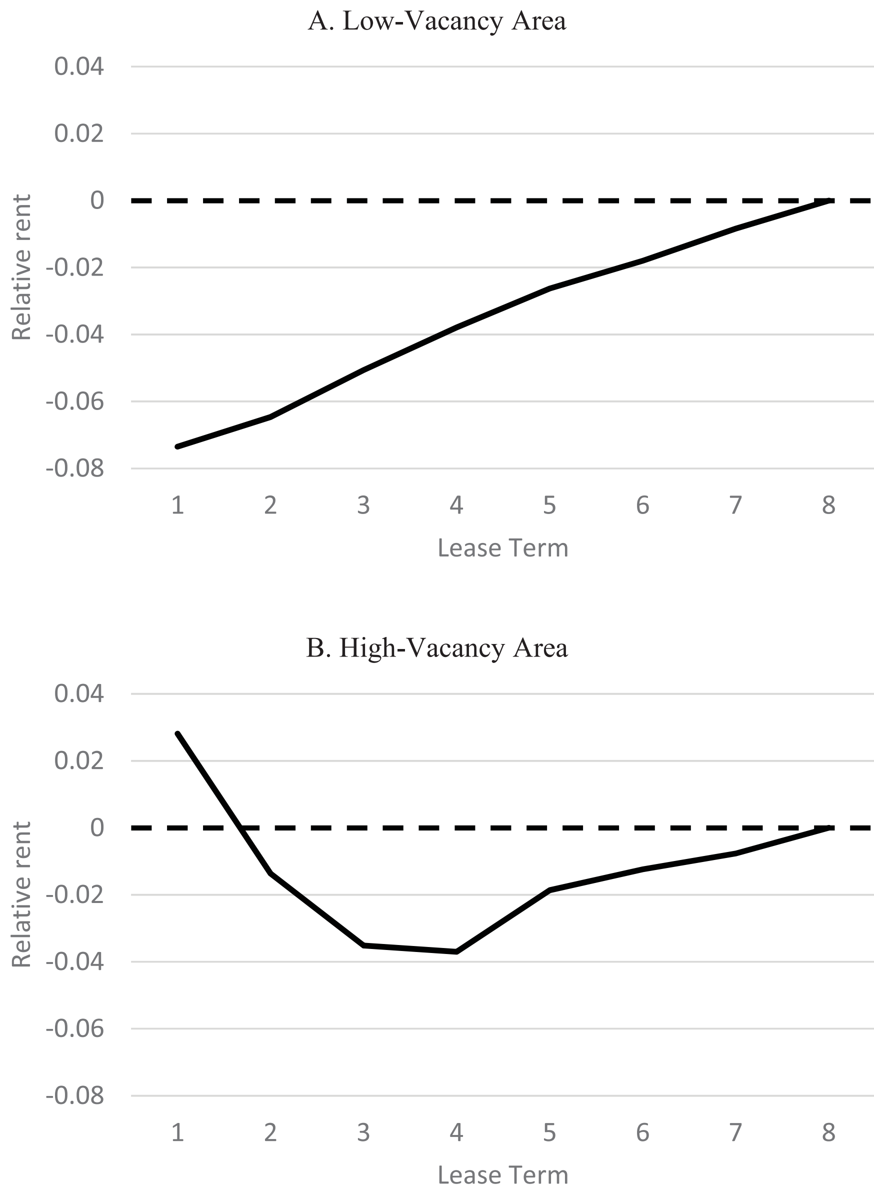
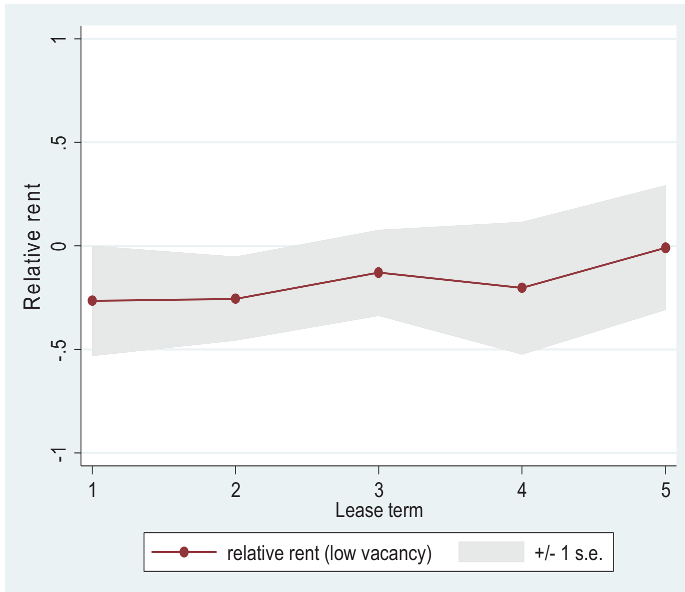


Figure 4
The model's predictions regarding Japanese lease term structure
This figure depicts the term structure of fixed-term lease rates that is predicted by the calibrated model in Model Section. Panels A and B depict the results for the low- and high-vacancy areas, respectively. The vertical axis represents the initial rent relative to the general lease rent (i.e., open-ended cancellable lease rent), which is indicated by the dashed line at zero. A negative (positive) value indicates the rate of discount (premium) to the general lease rent. The parameter values are: the annual risk-free rate is 1%, the annual rent volatility is 8%, the annual rate of rent growth is 1%, the risk premium on the short-term rent is 1%, and the vacancy rate is 5% for the low-vacancy area and 19% for the high-vacancy area.

A. Low-Vacancy Area



B. High-Vacancy Area

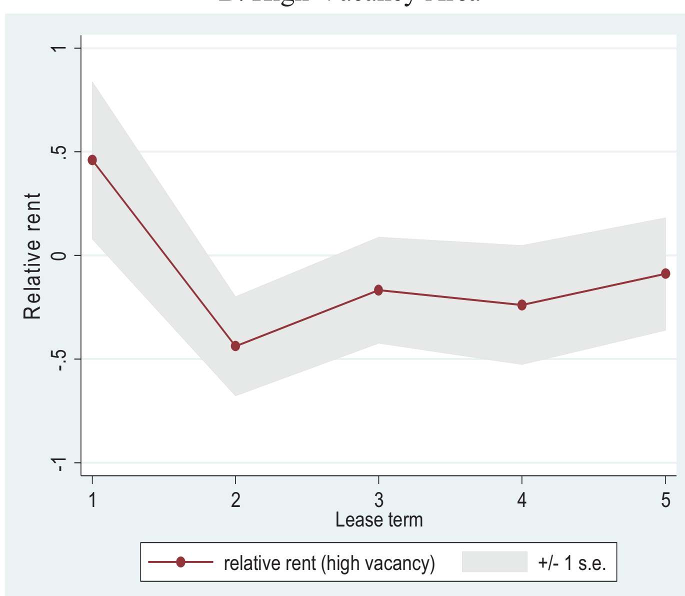


Figure 5 The relative rent for low- and high-vacancy areas

This figure depicts the estimated rents for fixed-term leases relative to the rent of a comparable general lease based on Model (e) of Table 3. Panels A and B depict the result for the low- and high-vacancy areas, respectively. The horizontal axis indicates lease term in years. The vertical axis is the relative rent (in 1000 yen/month/m^2) when the general lease rent is normalized to zero (i.e., predictive errors). Rents are evaluated for urban locations with the mean values of numeric control variables.

Web Appendices

Web appendices are available at: http://www.personal.psu.edu/juy18.